WirelessHART Resources

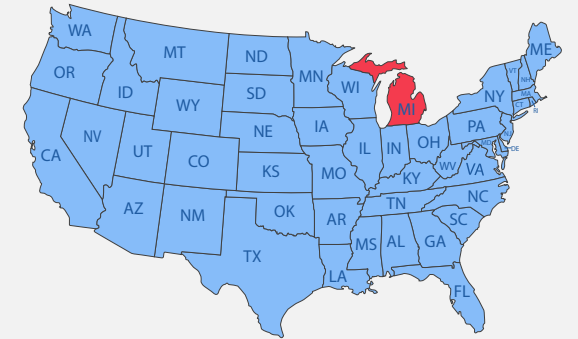[WirelessHART Solutions - YouTube](#)

https://store.fieldcommgroup.org/collections/training/products/wirelesshart-bootcamp-2022
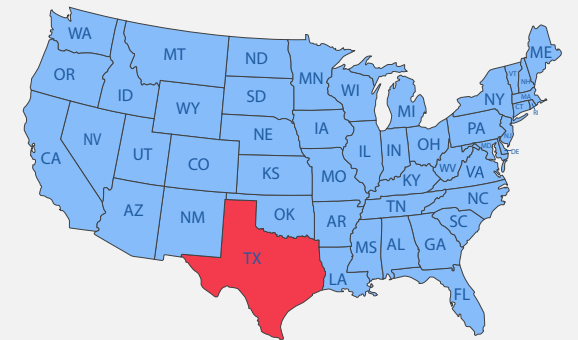
Shane Hale

Global Business Development Director – Pervasive Sensing
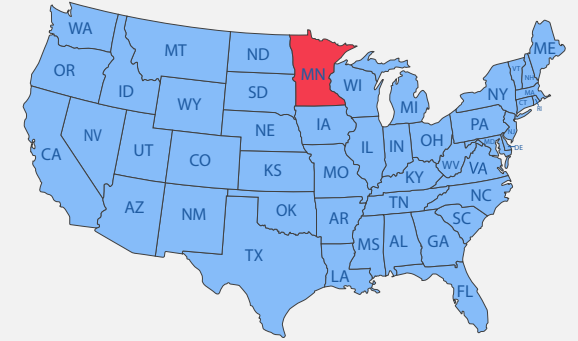
Philippe Moock

Global Director - Thermal Insight Group

Paul Sereiko

Director - Marketing and Product Strategy

4

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WirelessHART Facts

- Architected to meet rigorous requirements for industrial process automation

- International standard IEC62591 – approved January 2009

- Built on the **solid foundation of the HART open protocol** - deployed since 1986

- Deployed ecosystem of 50K+ networks.

- Same application layer is used in HART and WirelessHART

- FieldComm Group is tasked with:
  - Defining and maintaining clear specifications
  - Ensuring Interoperability through registration program
  - Providing training workshops and in-depth support

Components of a WirelessHART Network

Signal Range

Ethernet
Serial
Wi-Fi
LTE/5G

HART-IP
OPC
Modbus TCP
Ethernet/IP
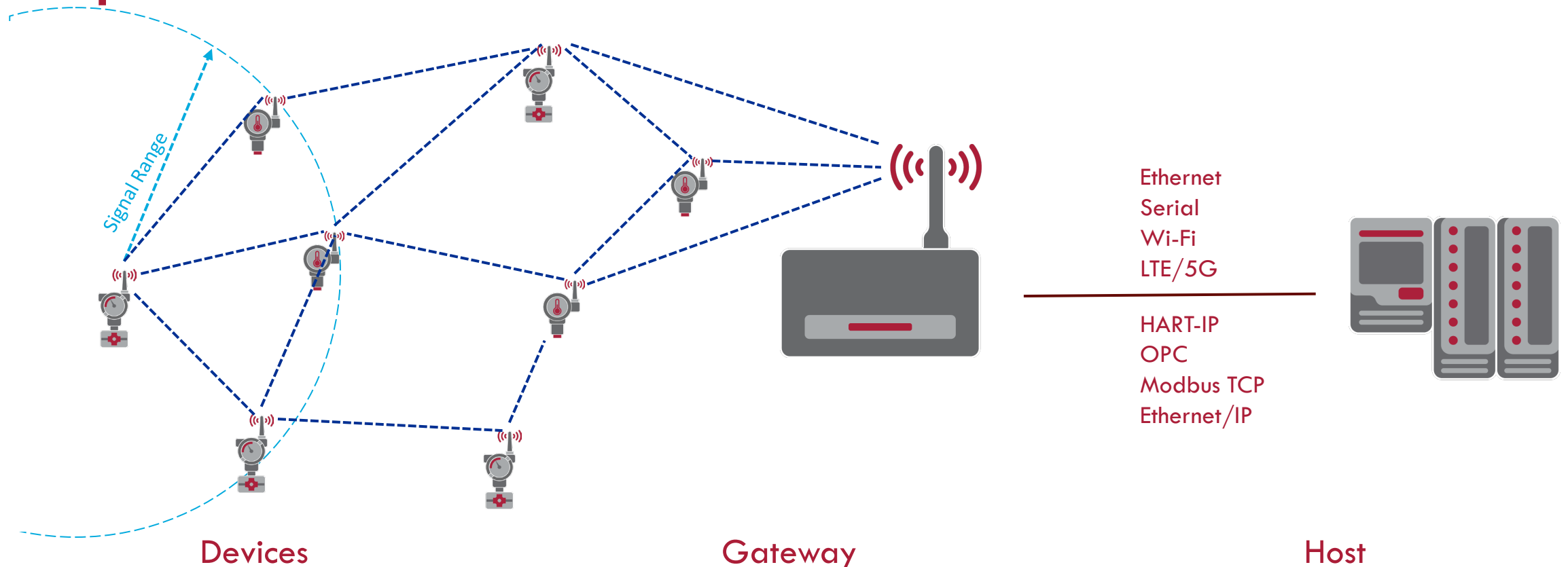
Devices

WirelessHART sensors from multiple vendors used for process and asset monitoring

Gateway

Connects to sensors and manages the mesh network to optimize reliability

Host

Data communication with wide range of secure, industry standard protocols

Network Design "Good Practice" Recommendations

Network Design "Good Practice" Recommendations

1. Locate gateway antenna near the center of a network

Network Design "Good Practice" Recommendations

1. Locate gateway antenna near the center of a network

Network Design "Good Practice" Recommendations

✔ 1. Locate gateway antenna near the center of a network

Network Design "Good Practice" Recommendations

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2. 5 devices within direct range of the gateway antenna

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Network Design "Good Practice" Recommendations

1. Locate gateway antenna near the center of a network

2. 5 devices within direct range of the gateway antenna

3. 25% of network within range of the gateway antenna

Network Design "Good Practice" Recommendations

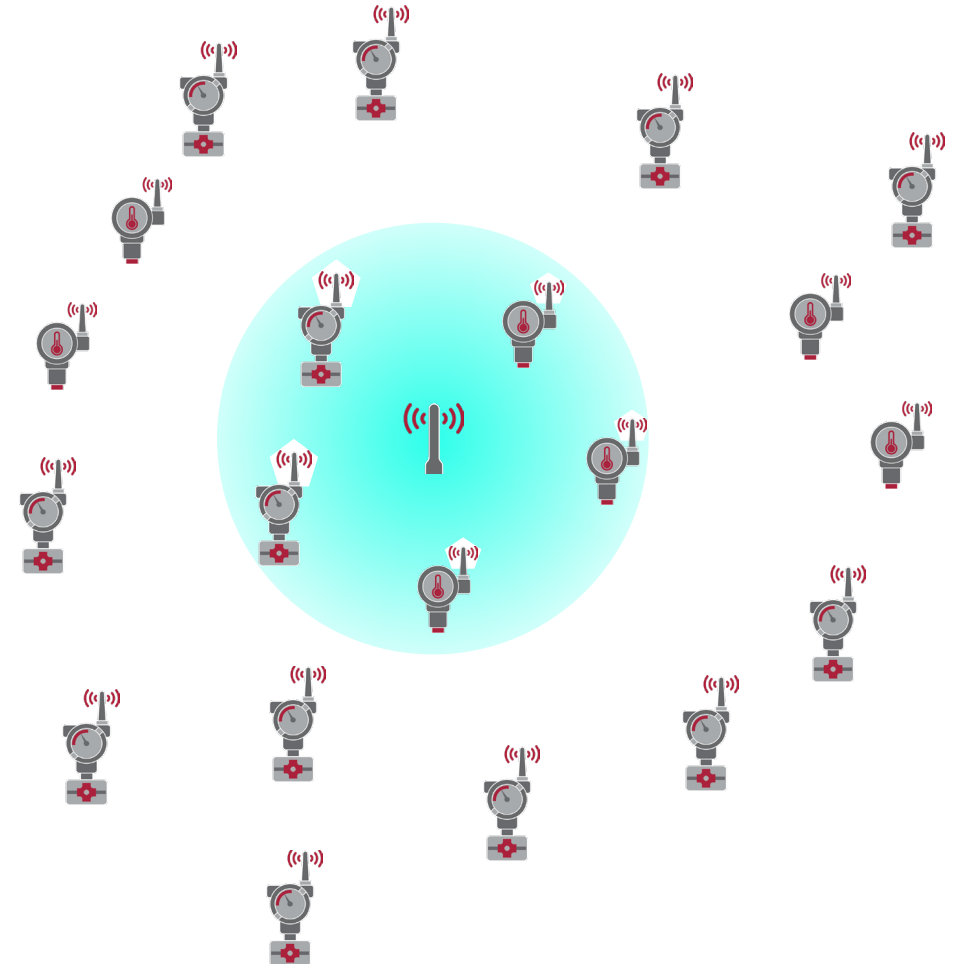✅ 1. Locate gateway antenna near the center of a network

✅ 2. 5 devices within direct range of the gateway antenna

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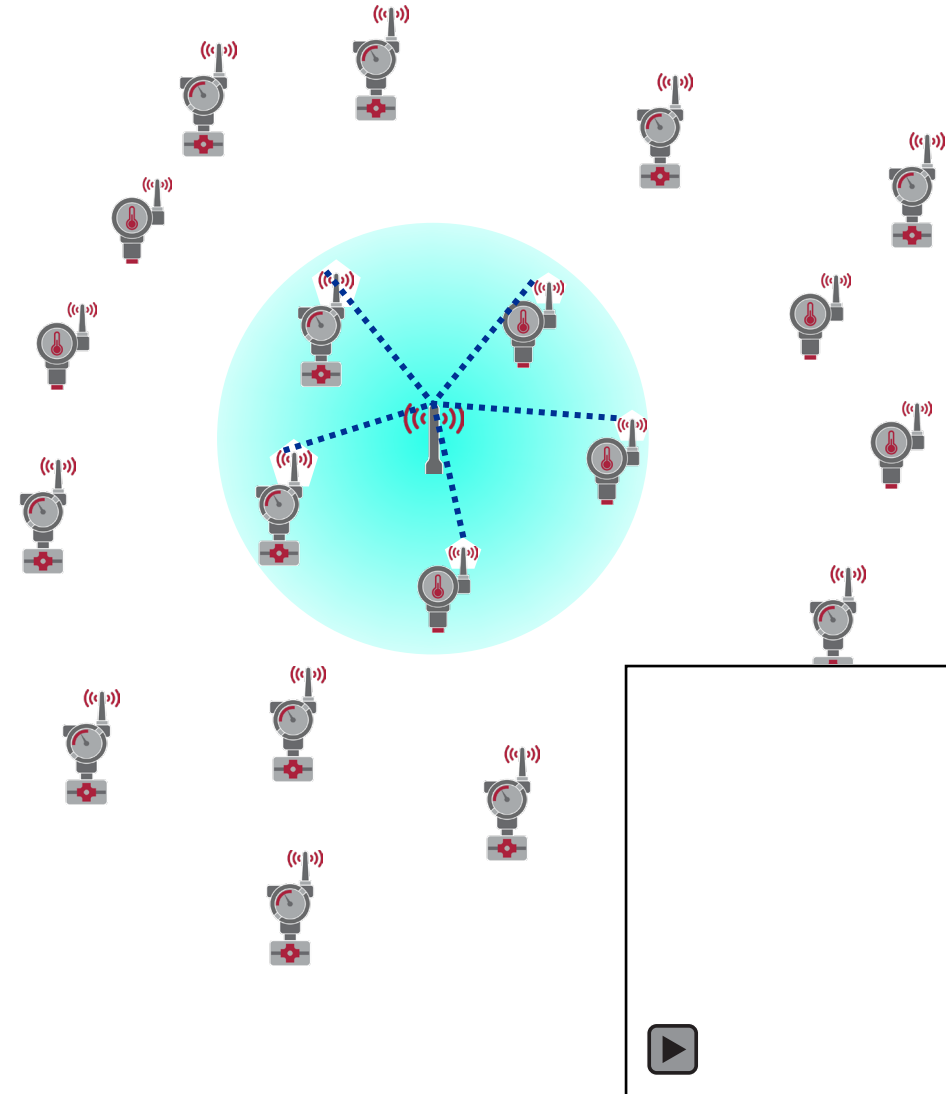| Number of Devices	20
Devices Connected to Gateway	5
Percent Direct Connect	25%

Network Design "Good Practice" Recommendations

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✓ 3. 25% of network within range of the gateway antenna

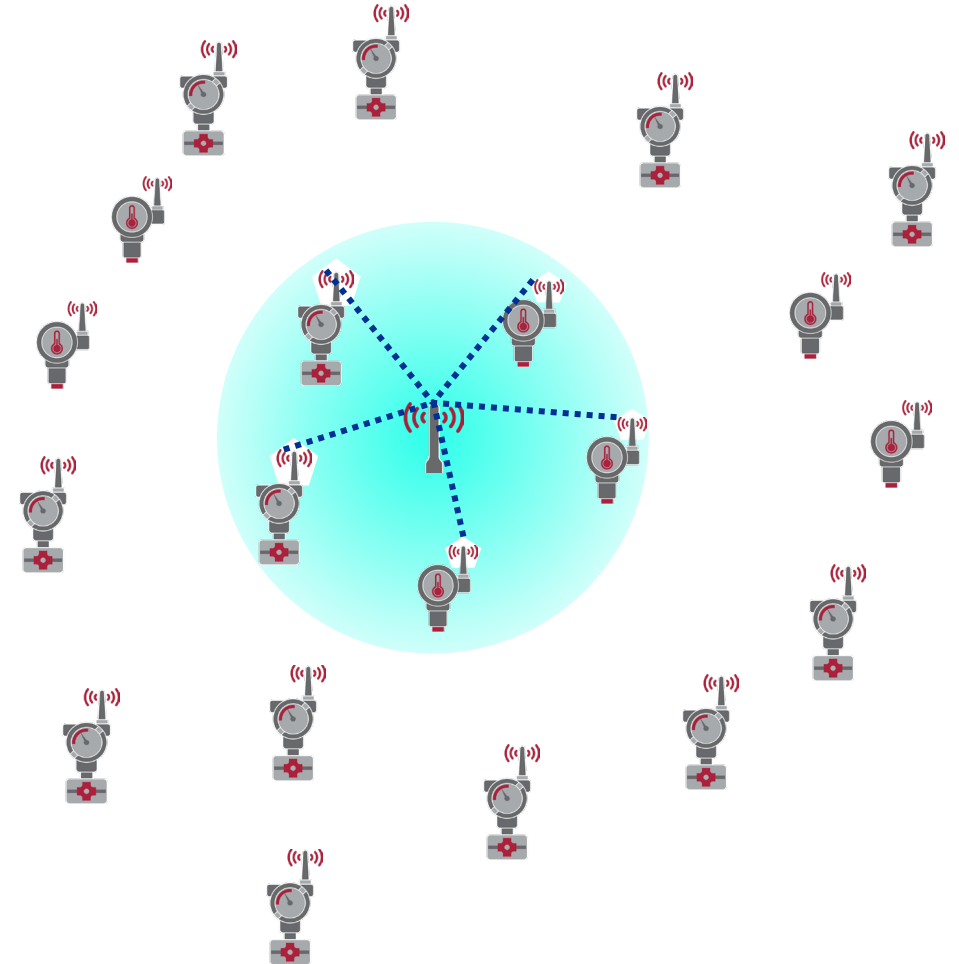| Number of Devices	20
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Percent Direct Connect	25%

4. 3 good neighbors for every device

Network Design "Good Practice" Recommendations

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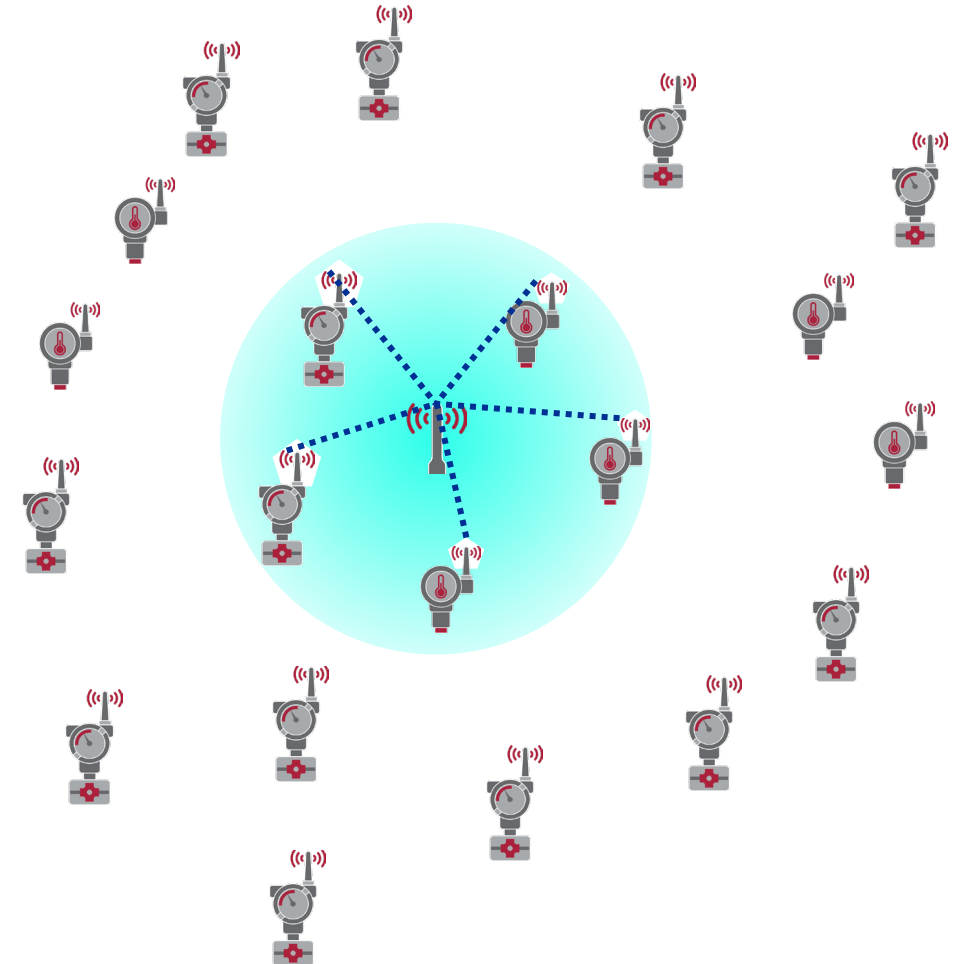
✓ 2. 5 devices within direct range of the gateway antenna

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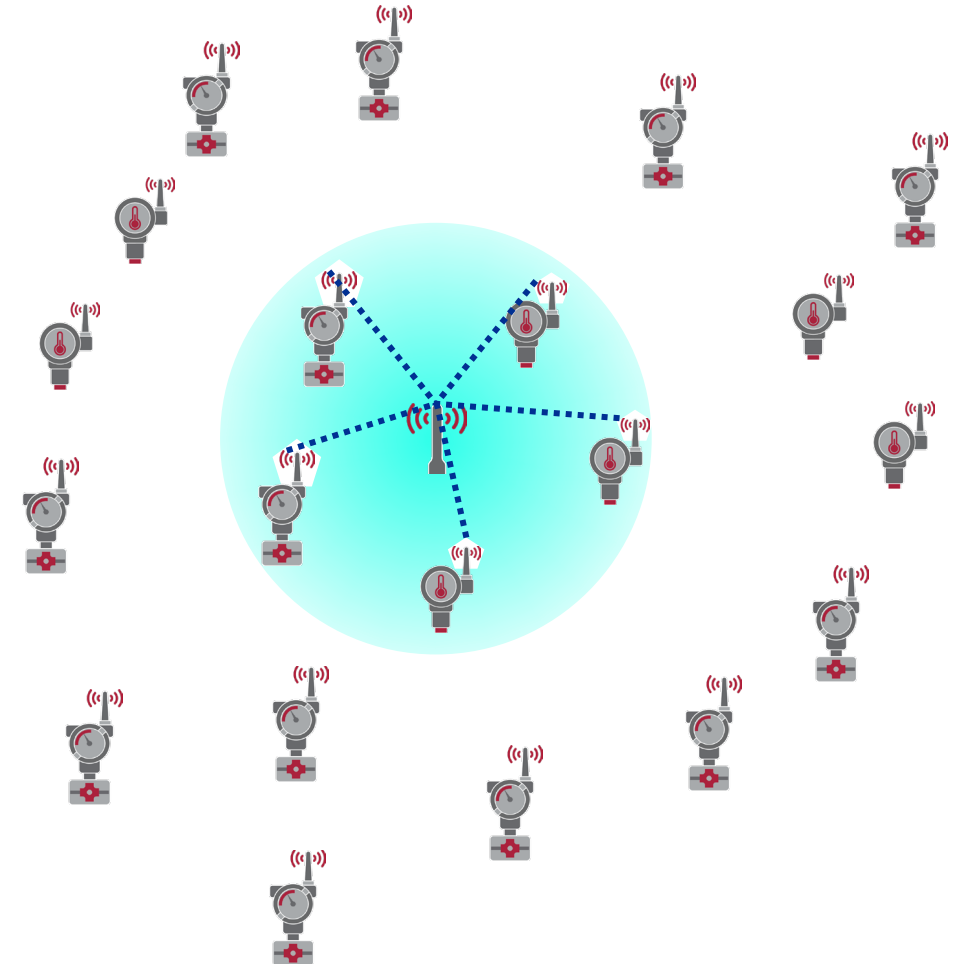
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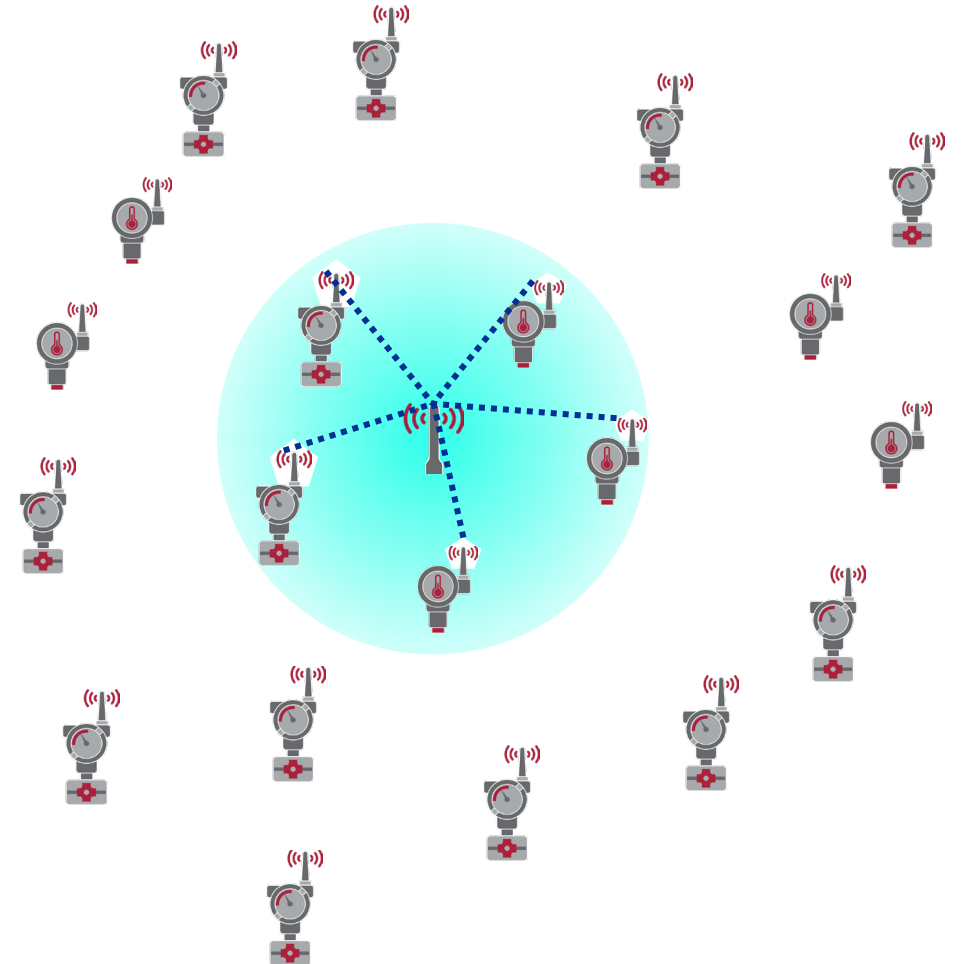
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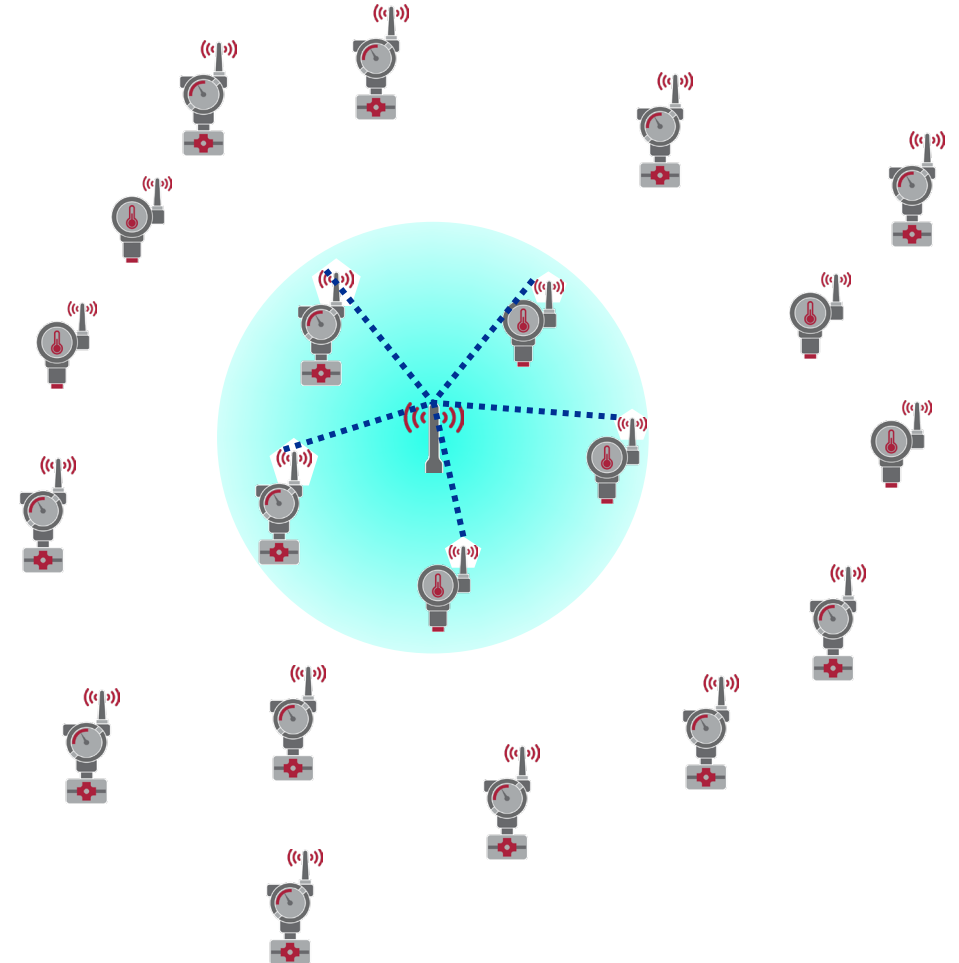| Number of Devices	20
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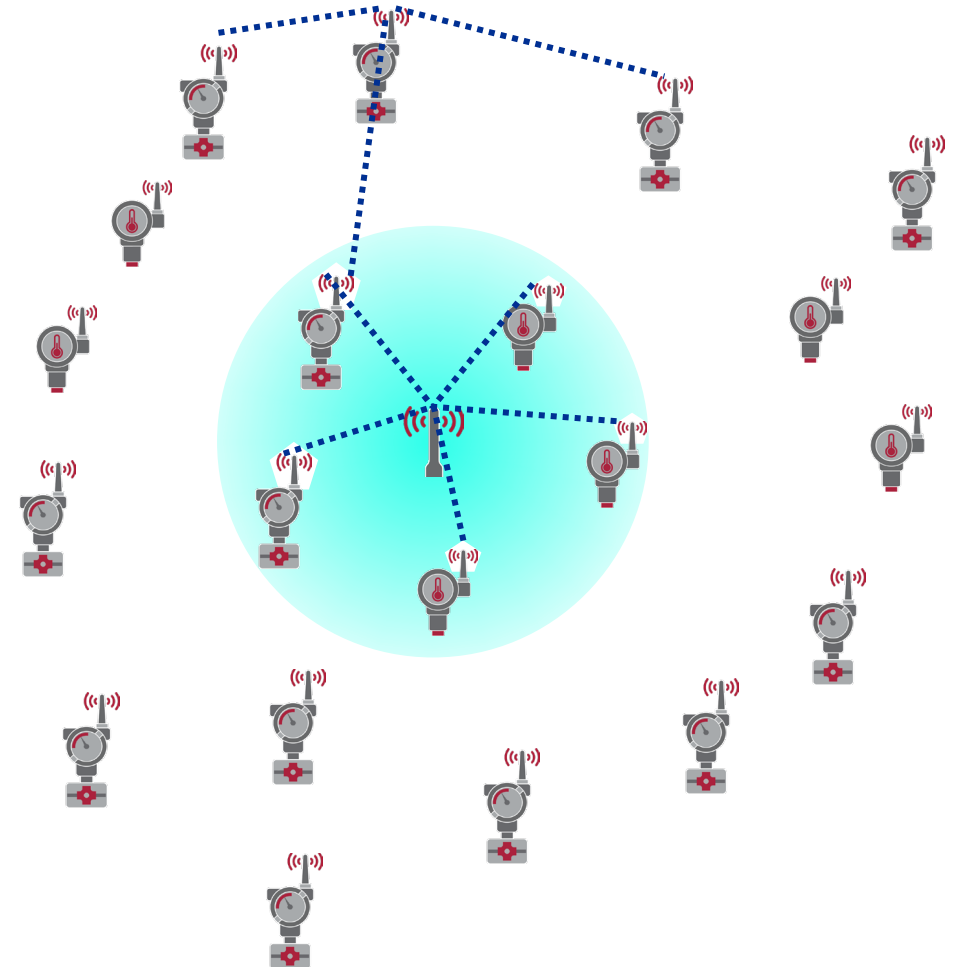
FieldComm Group
Connecting the World of Process Automation

Network Design "Good Practice" Recommendations

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4. 3 good neighbors for every device

A well-formed network will easily achieve 99% Data Reliability

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Signal Range Is Dependent on the Density of Obstructions

>½ mile, 2600ft 800m — **Line of Sight, Extended Range** – Extended range antennas above obstructions, up to 2 miles.

~750ft 230m — **Clear Line of Sight** – The antenna for the device is mounted above obstructions and the angle of the terrain change is less than five degrees.

~500ft 150m — **Light Obstruction** - Typical of tank farms. Despite tanks being big obstructions themselves, lots of space between and above makes for good RF propagation.

~250ft 80m — **Medium Obstruction** - Process areas where lots of space exists between equipment and infrastructure.

~100ft 30m — **Heavy Obstruction** - Heavy density plant environment; where a truck or equipment cannot be driven through.

Sustainability Defined

Sustainable initiatives are various approaches that aim to improve the chances of long-term success by promoting efficient and responsible resource use. Being sustainable as an organization generally refers to its ability to achieve its business goals without affecting future generations by depleting their resources. — Indeed

Sustainability has emerged as the linchpin across industries and is defined as "meeting the needs of the present without compromising the ability of future generations to meet theirs." — ARC Research and United Nations

NBC New York
0:43
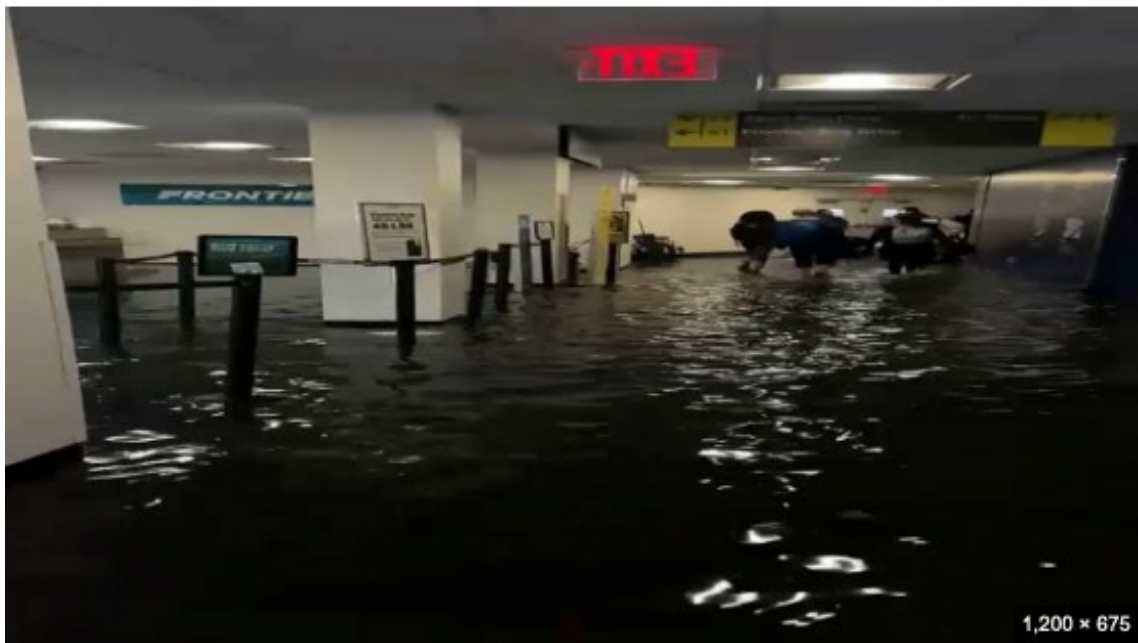
LaGuardia Airport's Terminal A reopens after flooding, travelers walking in inches of water

Uploaded: Sep 29, 2023

LaGuardia Airport's Terminal A was forced to close down entirely before 11 a.m. after the building itself flooded as a result of the heavy rain.

Images may be subject to copyright. Learn More

1,200 × 675

Watch

Software enables efficient energy and process design and operation.

rgy optimization decarbonization eves eco-efficiency.

Sustainability

Automation optimizes energy and resource use.

The Industrial Sustainability Triad

WORLD ECONOMIC FORUM

McKinsey & Company

zvei
electrifying ideas

Emissions Management
Venting, flaring, fugitive, exhaust, bleed

Emissions monitoring & control

Carbon capture utilization and storage (CCUS)

Hydrogen & hydrogen-based fuels

Energy Source Decarbonization
Ammonia, methanol
Biofuels, LNG

Low-carbon fuels

Low-carbon power

Solar, wind, nuclear

Recommendations

Automation

Advanced controls & analytics

Equipment and process performance

Energy storage

Simulation and Remote monitoring

Normally not manned

Lithium, battery cells

Electrification

Energy Efficiency & Optimization

SOFTWARE FOR SUSTAINABILITY
- Efficiency
- Loss control
- Accountability

- No platform dependance
- No custom API
- No custom coding

SUSTAINABLE 4IR SOFTWARE

Industrial automation can lower the industry's impact on the environment

Software enables efficient energy and process design and operation.

rgy optimization decarbonization eves eco-efficiency.

Sustainability

Automation optimizes energy and resource use.

The Industrial Sustainability Triad

https://www.weforum.org/agenda/2022/01/industrial-automation-matters/
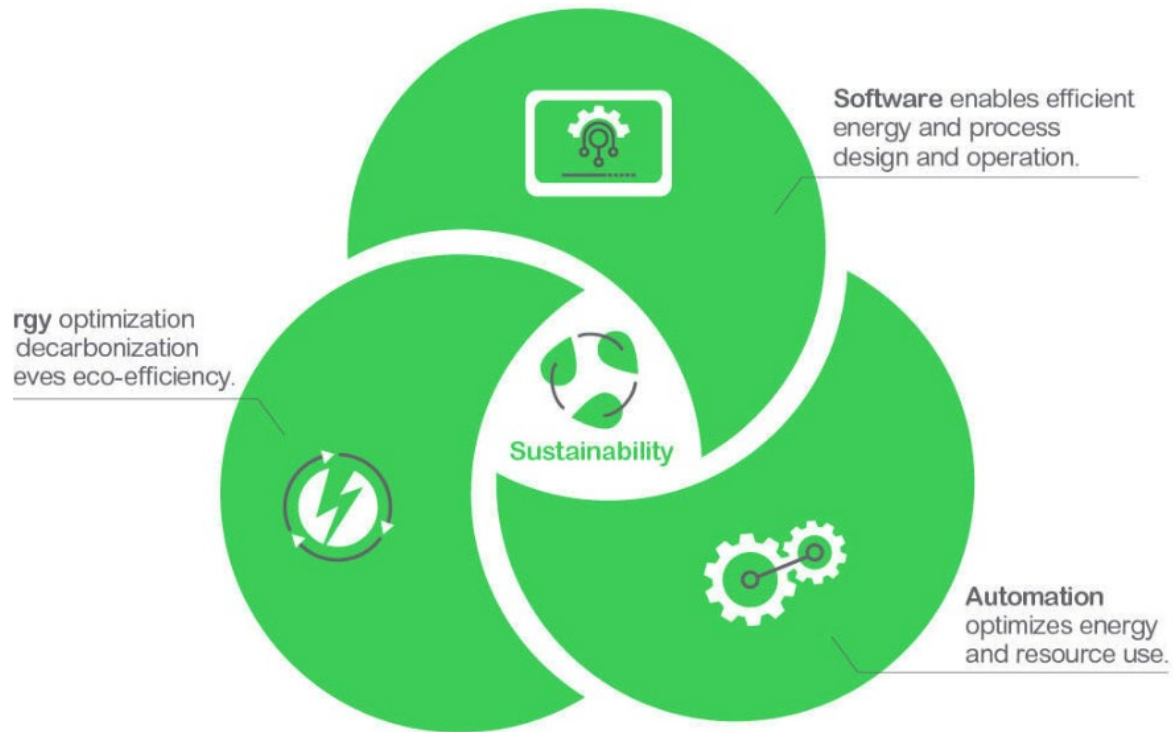
Image: Schneider Electric

In collaboration with
McKinsey & Company

WORLD
ECONOMIC
FORUM
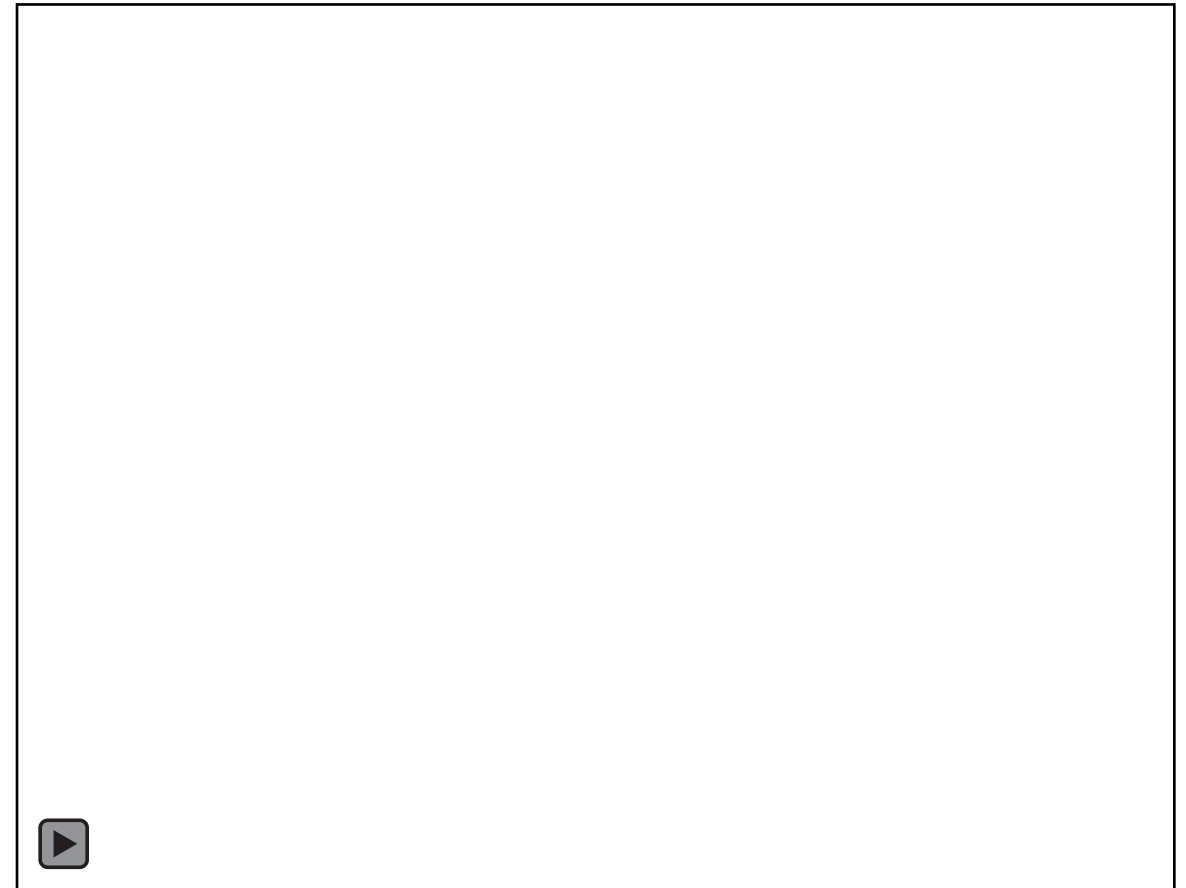
Global Lighthouse Network:
Shaping the Next Chapter of the
Fourth Industrial Revolution

WHITE PAPER
JANUARY 2023

Process industries

Baoshan Iron & Steel
Steel products, Shanghai, CN

DCP Midstream
Oil and gas, Denver, CO, US

Huayi New Material
Chemicals, Shanghai, CN

MODEC
Oil and gas, Rio de Janeiro, BR

Petkim
Chemicals, Izmir, TR

Petrosea
Mining, Tabang, ID

POSCO
Steel products, Pohang, KR

Renew Power
Renewable energy, Hubli, IN

Saudi Aramco
Oil and gas, Abqaiq, SA

Saudi Aramco
Oil and gas, Khurais, SA

Saudi Aramco
Oil and gas, Uthmaniyah, SA

STAR refinery
Oil and gas, Izmir, TR

Tata Steel
Steel products, Ijmuiden, NL

Tata Steel
Steel products, Jamshedpur, IN

Tata Steel
Steel products, Kalinganagar, IN

Pharmaceuticals and medical products

Agilent Technologies
Medical equipment, Singapore, SG

Bayer
Pharmaceutical, Garbagnate, IT

Cipla
Pharmaceuticals, Indore, IN

Dr. Reddy's Laboratories
Pharmaceuticals, Hyderabad, IN

GE Healthcare
Medical equipment, Hino, JP

GSK
Pharmaceuticals, Ware, UK

Johnson & Johnson Consumer Health
Self-care products, Bangkok, TH

Johnson & Johnson Consumer Health
Self-care products, Helsingborg, SE

Johnson & Johnson Consumer Health
Self-care products, Mulund, IN

Johnson & Johnson DePuy Synthes
Medical devices, Bridgewater, NJ, US

Johnson & Johnson DePuy Synthes
Medical devices, Cork, IR

Johnson & Johnson DePuy Synthes
Medical devices, Suzhou, CN

Johnson & Johnson Janssen
Pharmaceuticals, Cork, IR

Johnson & Johnson Janssen
Pharmaceuticals, Latina, IT

Johnson & Johnson Vision Care
Medical devices, Jacksonville, FL, US

Johnson & Johnson Vision Care
Medical devices, London, UK

Novo Nordisk
Pharmaceuticals, Hillerød, DK

Sanofi
Pharmaceuticals, Paris, FR

Teva
Pharmaceuticals, Amsterdam, NL

Zymergen
Biotechnology, Emeryville, CA, US

Source: World Economic Forum Global Lighthouse Network

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Global Lighthouse Network: Huayi New Material

Huayi New Material
Shanghai, CN

To respond to external challenges, such as 30% over-capacity and higher costs due to market volatility, the company has deployed 28 different Fourth Industrial Revolution use cases, such as machine-learning-enabled process optimization and AI-enabled safety management. As a result, labour productivity increased by 33%, conversion cost fell by 20%, energy consumption dropped 31%, and recordable safety incidents reached zero.

| Use case	Change	Metric
Digitally enabled profit optimizer across value chain	↑ 15%	Inventory turnover
Machine learning enabled chemical reactor optimization	↓ 22%	Material waste
IIoT enabled equipment monitoring and failure diagnosis	↑ 10%	OEE
Artificial intelligence enabled safety management	↓ 100%	Total recordable incident rate
Advanced analytics enabled steam network optimization	↓ 38%	Steam consumption
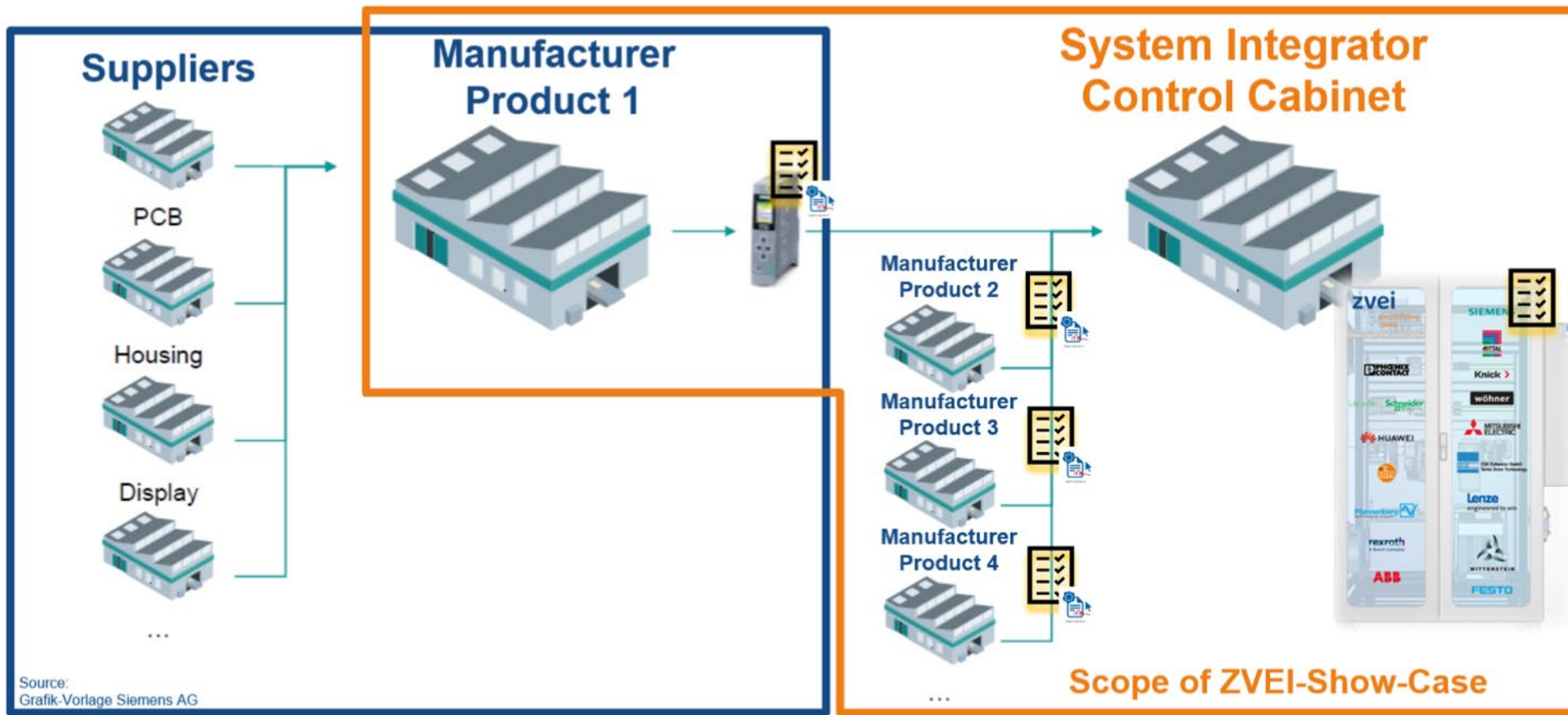
Illustration 2: Scope of the ZVEI-Show-Case PCF@Control Cabinet

© FCG
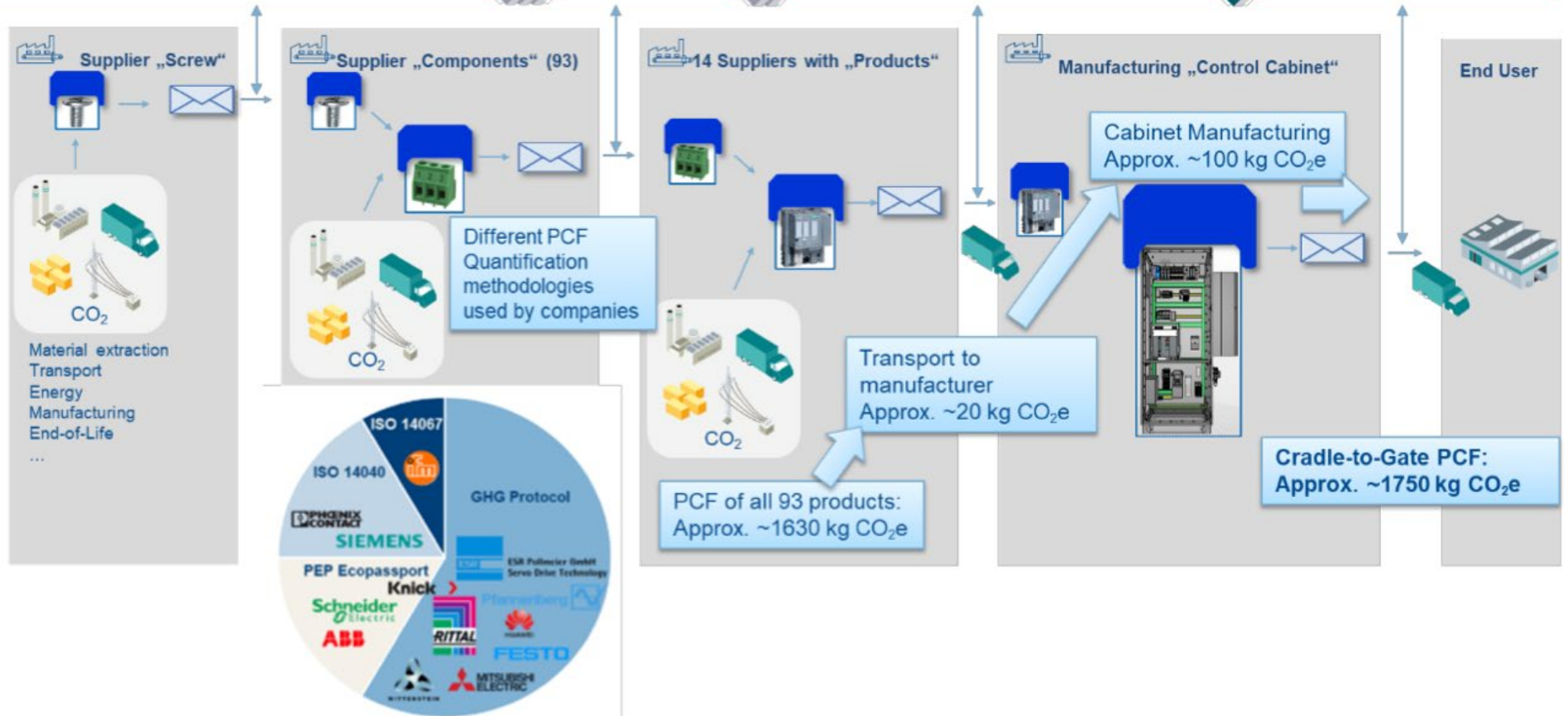
Illustration 1: Exemplary value chain of the ZVEI-Show-Case PCF@Control Cabinet

ALTERNATIVE

RECYCLING

SAFETY

GREEN

SMART

INNOVATION

SUSTAINABILITY

ENERGY

RENEWABLE

ENVIRONMENT

ENERGY SAVING

DEVELOPMENT

PEOPLE

WIRELESSHART – A KEY ENABLER FOR SUSTAINABILITY EFFORTS

Webinar Speaker

EMERSON

Shane has over 25 years' experience in the instrumentation and control field in many industry segments including Oil & Gas, petrochemicals, and metals & mining. Shane joined Emerson 20 years ago as a field technician in Sydney, Australia, and has held various roles including project design & commissioning engineer for international projects, business development manager, director of product management, and now global director for business development for Emerson's pervasive sensing business. He is now living with his young family in Minneapolis, MN.

Shane Hale

Global Director of Business Development
Emerson - Pervasive Sensing

Sustainability and Missing Measurements

- Sustainability and decarbonization programs often require new measurements
  - Steam flow
  - PRV opening
  - Pipe corrosion
  - Heat exchanger inlet/outlet temperature and pressure
  - etc.
- Adding new wired measurements requires spare I/O, junction boxes, conduit, and cable
- The cost and time to add wired sensors can make many sustainability programs uneconomical
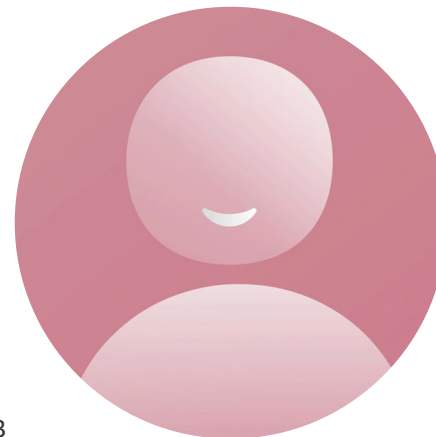
The Carbon Footprint of Wiring

Polyethylene

Copper

Aluminum Foil

PVC

PVC Conduit

Steel Conduit

Aluminum Cable Tray

Wired Sensors come with the additional cost of *cables, conduit, cable tray*, and other hardware which contribute to the total carbon footprint

WirelessHART

Sensors Reduce Engineering Effort and Carbon Footprint

70%
Hardware

75%
Engineering

95%
Space

92%
Weight

FIELDCOMM GROUP
Connecting the World of Process Automation
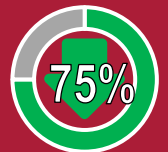
WirelessHART Enables Sustainability Measurements

Non-Intrusive Temperature

WirelessHART Gateway

Acoustic and Surface Temperature

Vibration

Non-Intrusive Corrosion

- WirelessHART Gateways can connect to up-to 200 devices, dramatically reducing the cost and time to add missing measurements

- Many wireless devices focus on non-intrusive measurements to facilitate installation on running processes

- Gateways can bypass the control system so that sustainability data is directly available on the corporate network and into the cloud

WirelessHART Network Architectures

L5 — Enterprise Network
L4 — Business Network
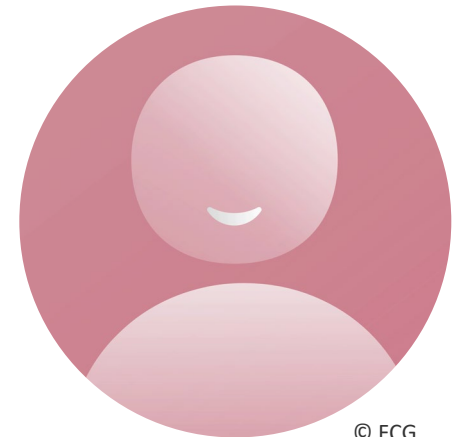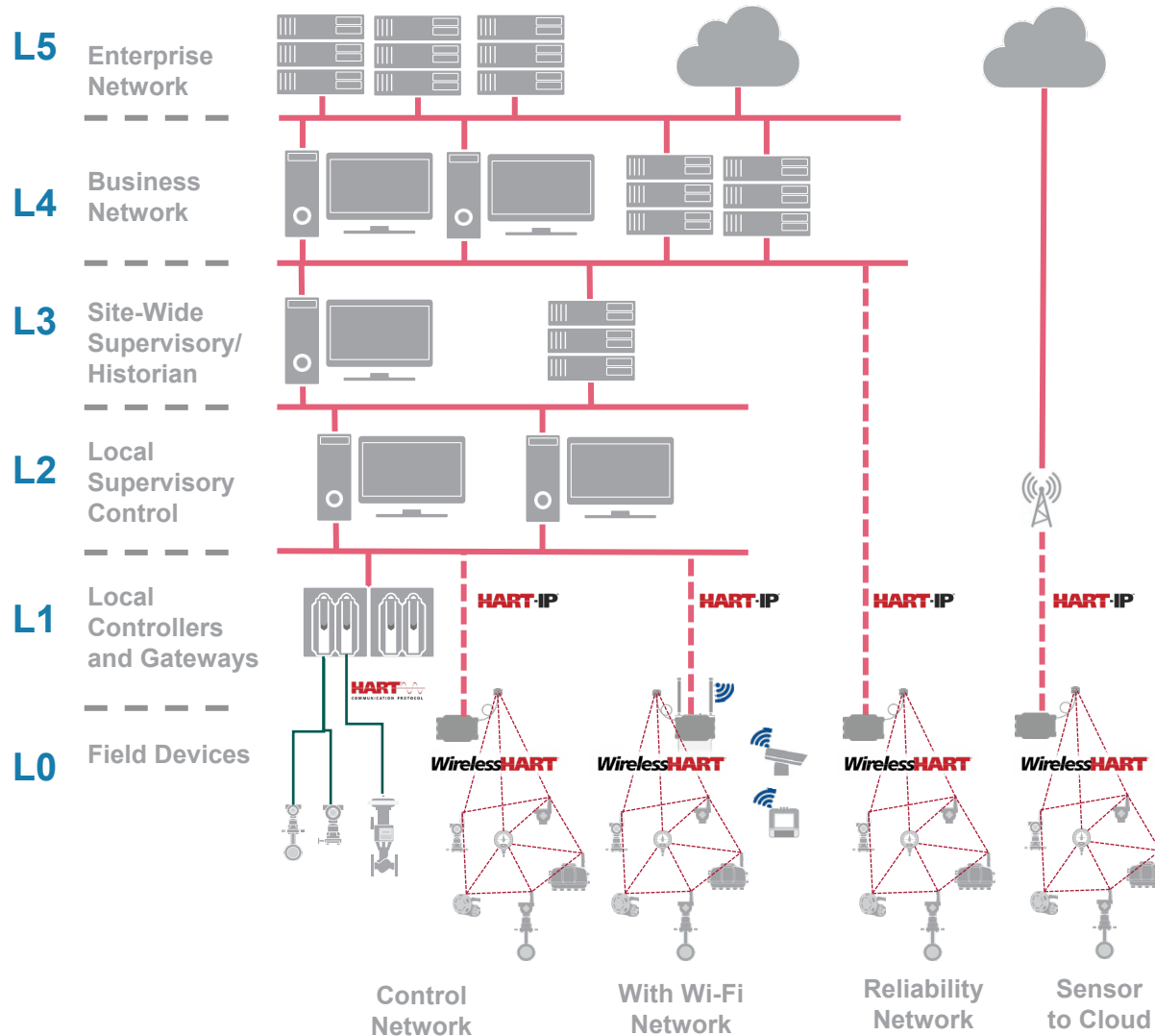L3 — Site-Wide Supervisory/ Historian
L2 — Local Supervisory Control
L1 — Local Controllers and Gateways
L0 — Field Devices

HART·IP

HART COMMUNICATION PROTOCOL

WirelessHART

Control Network | With Wi-Fi Network | Reliability Network | Sensor to Cloud
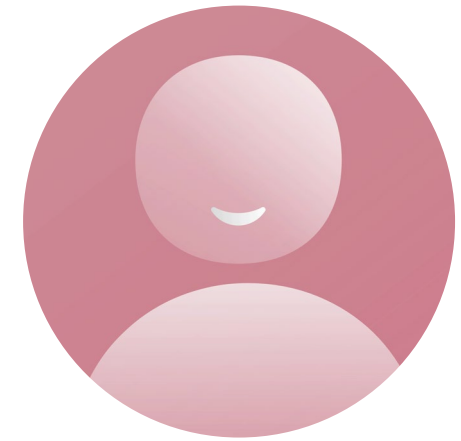
- Sustainability and Decarbonization measurements are not used in the control strategy
- I/O for control systems are expensive, and are under strict change management
- Parallel "reliability networks" connect sensors directly to the business network
- Multiple WirelessHART networks can co-exist (with Wi-Fi & 4G/5G as well)
- Connections directly to the cloud enable enterprise-wide management or Monitoring as a Service by 3rd parties

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5

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Interoperability on WirelessHART Networks
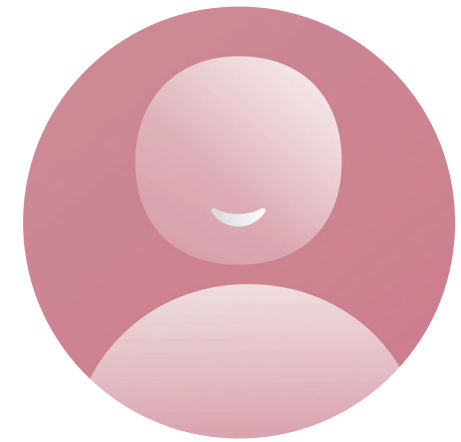
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

WirelessHART is the only "full-stack" industrial wireless protocol which includes how the data is presented to clients

All registered WirelessHART devices will work on the network and do not need "decoder" software to access the sensor data
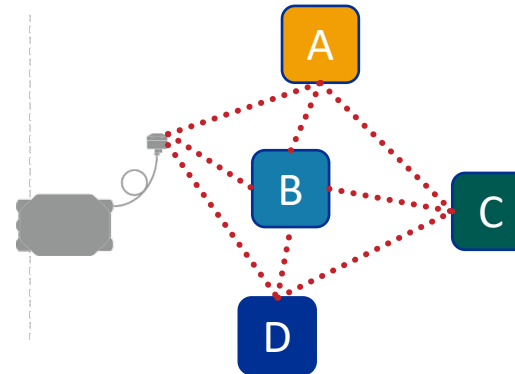
Using WirelessHART for sensors allows for different solutions from different vendors to work together seamlessly in a self organizing mesh network
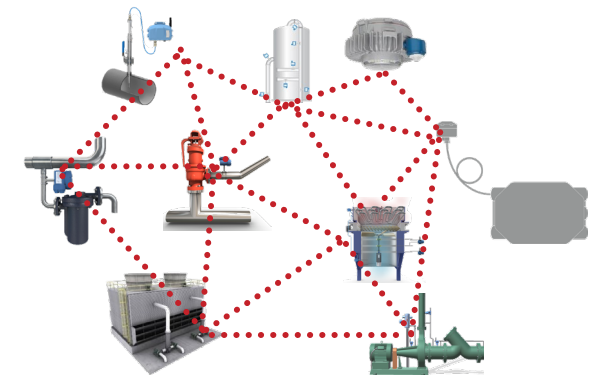
Reliability and automated manual round measurements can be added to the WirelessHART network to get added value from the infrastructure

WirelessHART Provides Reliability in Operations
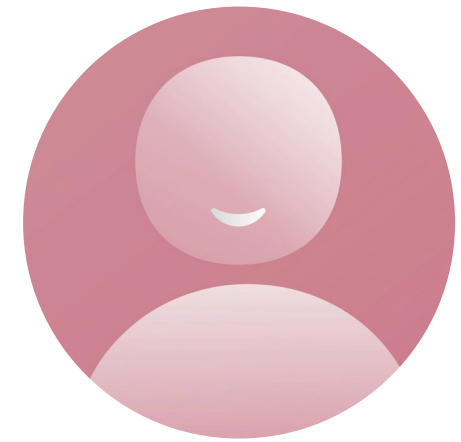
Adding missing measurements for sustainability and decarbonization efforts can add additional load on maintenance and operations

Using the industry-standard WirelessHART protocols ensures familiarity for maintenance crews, and ensures easy integration with existing systems

Gateway
Device
Wireless Link
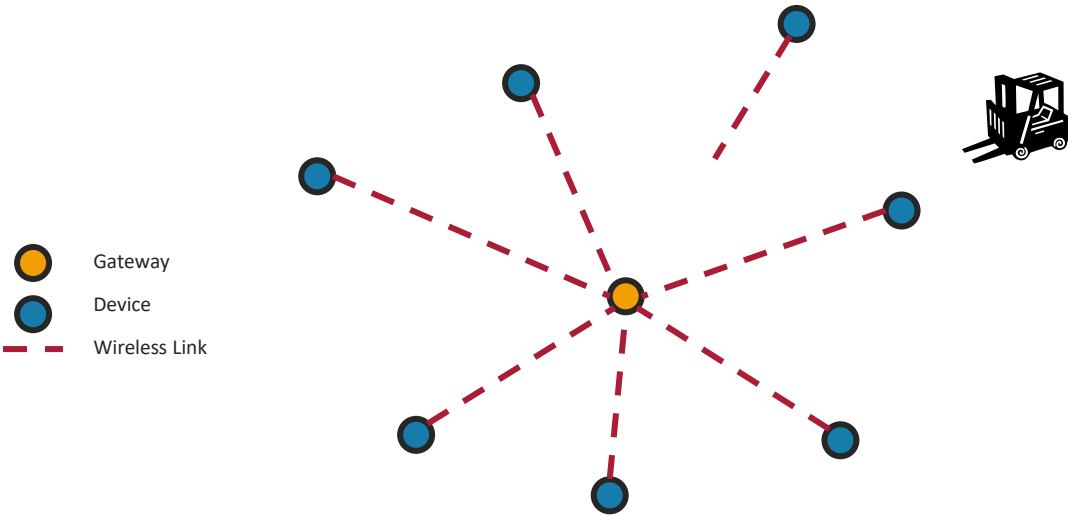
WirelessHART®

Star Topology Is Not Robust

- Devices only communicate with the gateway and all devices must be within communication range

- When communication is obstructed, communication is lost
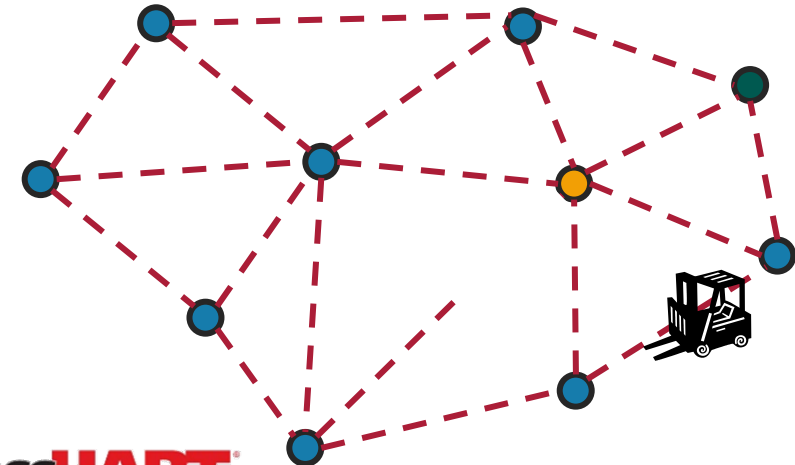
Self-Organizing Mesh Network Self Heals

- Devices communicate with any other node in the network, and can hop back to the gateway

- Devices automatically "hop around" obstructions to find path back to gateway

Advantages Of Using WirelessHART For Sustainability

✓ Significantly reduced cost and time to add missing measurements

✓ Various network architectures available depending on the application and site preferences

✓ Devices from different vendors work seamlessly and do not need "decoder" software to operate

✓ Self-organizing mesh network operation increases signal reliability in changing plant environment

✓ Over 15 years of real-world industrial operating experience provides confidence in solutions
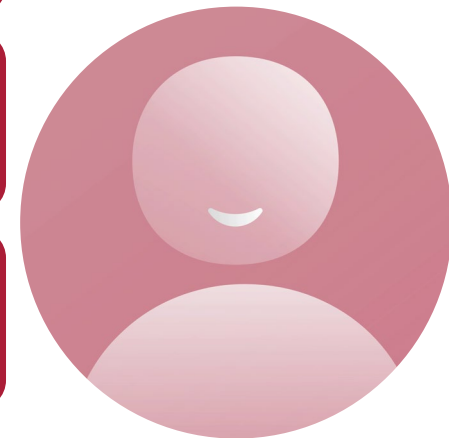
FieldComm Group™
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Process Automation

Speaker

Philippe Moock

Global Director Thermal Insight Group

Armstrong International

pmoock@**armstrong**international.com

armstronginternational.com

Topics

- Armstrong International

- Roadmap to Decarbonization

- Steam Trap Monitoring
  - Steam Trap Failures
  - Cost of Steam
  - Steam Trap Testing
  - ST5700 series

- Acoustic Monitoring
  - Fugitive Emissions
  - Pressure/Safety Relief Valves
  - Four Benefits of Valve monitoring
  - AD5000 series

Armstrong International

Belgium since 1969

USA since 1900

India since 2008

China since 1995

Roadmap to Decarbonization

Steam Trap Failure

	Service Life (in Years)	Annual Failure Rate	Light Industry
Low Pressure (< 75 psig) – Tracing or Drip			**50%**
Thermodynamic (Disc)	7	14%	20%
Inverted Bucket	15	7%	15%
Bimetallic	10	10%	30%
Wafer or Bellow	8	13%	25%
Float & Thermostatic	8	13%	10%
Medium Pressure (75 – 200 psig) – Process			**45%**
Thermodynamic (Disc)	5	20%	40%
Inverted Bucket	10	10%	10%
Float & Thermostatic	5	20%	50%
High Pressure (200 – 400 psig) – Drip			**5%**
Thermodynamic (Disc)	3	33%	60%
Inverted Bucket	7	14%	20%
Bimetallic	6	17%	10%
Float & Thermostatic	6	17%	10%
Annual Failure Rate		**14.6%**	

Steam Trap Failure

- If a steam trap **fails closed** (cold):
  - Wet steam
    - Water hammering
    - Damaged turbine LP saturated steam stage
    - Piping corrosion
    - Erosion on valves, reducers
  - Flooded heat exchanger
    - Decrease in production
    - Reduced heat transfer
    - Batch process losses
    - Thermal stress
  - Non-Condensable Gases in the system
    - Air is an insulator: heat exchanger less efficient
    - Oxygen in the pipe = corrosion: $H_2O + CO_2 -> H_2CO_3$ (Carbonic Acid)
    - System binding: flow of steam and condensate can be blocked
    - Temperature drops because steam pressure drops
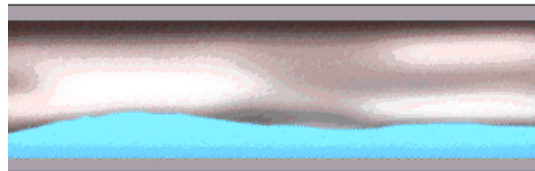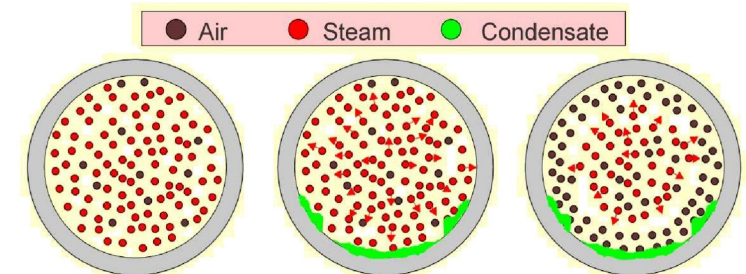
Steam Trap Failure

- If a steam trap fails open (leaking or blow-thru):
  - Increased back pressure in condensate return line
    - Reduced flow for surrounding steam traps
    - Stalling surrounding heat exchanger
  - Steam losses (monetary losses)
  - Safety issue
  - Environmental issue

Cost of Steam

- Cost of steam includes
  - Fuel
  - Make-up water
  - Chemicals
  - Sewage
  - CO2 emissions
  - …

If we only take the fuel cost into consideration:

Heat Cost for 100psig steam [$/1,000lbs] = **Fuel costs** [$/MMBtu] / **Boiler Efficiency**

Cost of Steam

Cost of Natural gas	Heat cost for 100psig steam
$5/MMBtu	$6.25/1,000lbs
$10/MMBtu	$12.50/1,000lbs
$20/MMBtu	$25/1,000lbs
$60/MMBtu	$120/1,000lbs
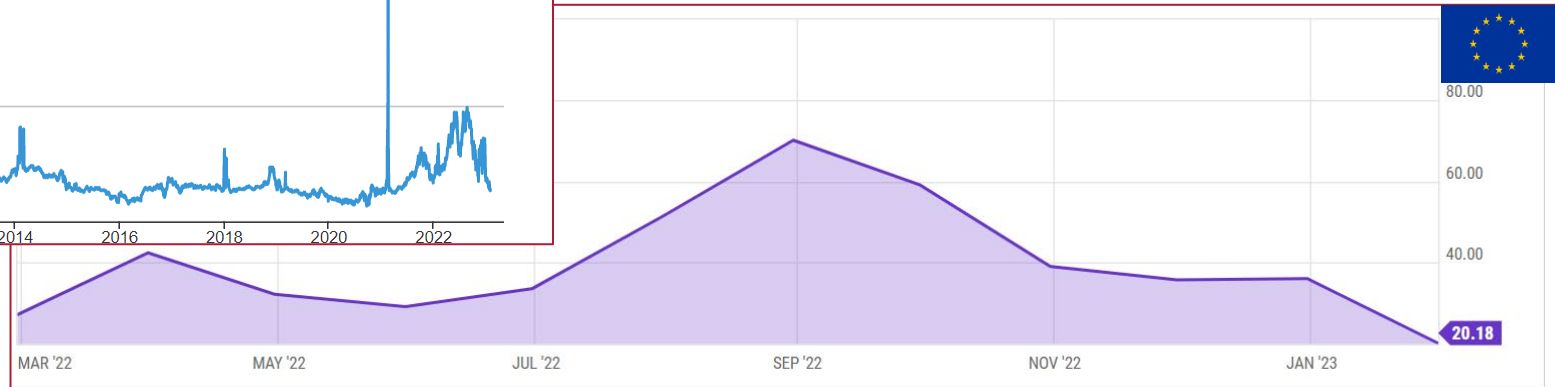
Steam Trap Failure [lbs/day]

Orifice	psig							
	15	30	60	100	150	250	400	600
#60	31	46	77	118	169	272	427	632
3/64"	42	63	106	162	233	374	586	869
1/16"	75	112	188	288	414	665	1,042	1,544
5/64"	117	175	293	450	646	1,039	1,628	2,413
3/32"	168	253	422	648	931	1,496	2,344	3,474
#38	197	296	495	760	1,091	1,754	2,747	4,072
7/64"	228	344	575	882	1,267	2,036	3,190	4,729
1/8"	298	449	751	1,153	1,655	2,660	4,167	6,177
9/64"	378	568	950	1,459	2,095	3,366	5,274	7,817
5/32"	466	702	1,173	1,801	2,586	4,156	6,511	9,651
11/64"	564	849	1,419	2,179	3,129	5,029	7,878	11,678
3/16"	671	1,011	1,689	2,593	3,724	5,984	9,376	13,897
7/32"	914	1,376	2,299	3,530	5,068	8,145	12,761	18,916
1/4"	1,194	1,797	3,002	4,610	6,620	10,639	16,668	24,706
9/32"	1,511	2,274	3,800	5,835	8,378	13,465	21,095	31,269
5/16"	1,865	2,807	4,691	7,203	10,343	16,623	26,043	38,603

$10/1,000 lbs.

⇩

$ 6,000/year

Blow-Thru Steam Trap, Outlet Pressure < (Inlet Pressure/2) - Source: AM0017 http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html

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How to Test Steam Traps?
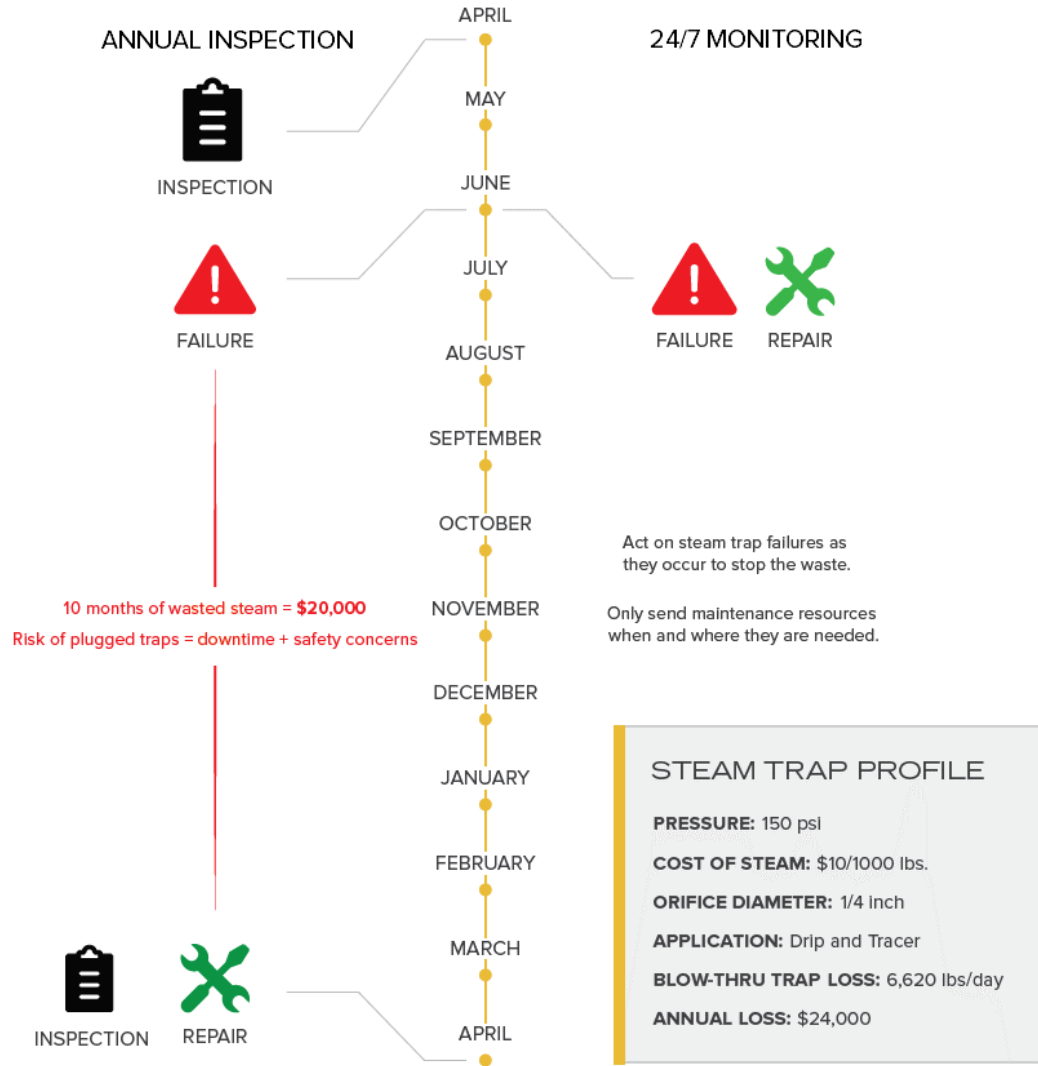
Steam Trap Monitoring

- ST5700 model
- Launched in 2011
- HART Registered
- 4-year battery life
- Non-intrusive installation
- Class I, Division 1, Zone 0

Variable	Description
PV	Steam Trap Condition: 1=OK, 2=COLD, 3=BLOW-THRU
SV	Current Temperature (°C or °F)
TV	Temperature (°C or °F)
QV	Battery Life (days)

Fugitive Emissions

Fugitive emissions are unintended or irregular releases of gases or vapors from pressurized system, either due to faulty equipment, leakage, or other unforeseen mishaps.

Leak detection is an essential component of risk management as it allows the operator to respond to the leaks to prevent further escalation of incidents.

Pressure/Safety Relief Valve

Pressure/Safety Relief Valves are necessary to the protection of many processes but most of these are known to be continuous sources for leakage.

Regardless of whether these gases, hazardous area pollutants or more benign fluids such as steam, are released to an enclosed recovery system or to the environment, it is important **to identify the source, time, and magnitude of the release.**

Benefits of Valve Monitoring

✓ **Safety**

It reduces exposure of employees to potentially harmful emissions and fluids as well as exposure of property to potentially highly corrosive fluids.

✓ **Environmentally**

It reduces global warming and greenhouse gases getting to the atmosphere.

✓ **Economically**

It makes sure the process is efficient by limiting downtime and reducing losses of pressurized gases.

✓ **Legally**

It helps avoid fines from local and states regulated by complying with legislation.

Acoustic Monitoring

- AD5000 model
- Launched in 2021
- HART Registered
- 4-year battery life
- Non-intrusive installation
- Class I, Division 1, Zone 0

Variable	Description
#0	Acoustic Level Counts (0-255)
#1	Stem Temperature (°C or °F)
#2	Occurrence Counter
#3	Occurrence Duration
#4	Battery Life
#5	Acoustic Level Threshold
#6	Sample rate (adjustable between 10s and 3,600s)

Theory of Operation
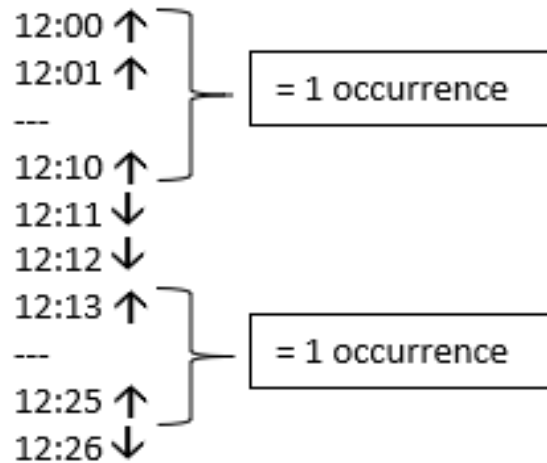
Example: A transmitter is set with a sample rate of 60s.
↑   to show that the measurement was above the threshold
↓   to indicate a reading below the threshold.

Occurrence Counter = 2 Occurrences

Occurrence Totalizer = 22 min = 1,320 seconds
12:00 to 12:10 = 10 min = 600s
12:13 to 12:25 = 12 min = 720s

Intelligent Monitoring Solutions

✓ 24/7 monitoring vs. point of time
✓ Quickly identify a failure (what, when, and where)
✓ Avoid unplanned downtime
✓ Cut labor cost
✓ Free up maintenance resources
✓ Increase efficiency
✓ Reduce energy consumption
✓ Short payback
✓ More devices on the steam system will strengthen the existing WirelessHART network

System Workplace

Control Room DCS

SAGE

Gateway

WirelessHART™ Device Mesh Network

FieldComm Group™
Connecting the World of Process Automation